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Case report

Autopsy diagnosis of a death due to scorpion stinging – A case report

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ABSTRACT

Post-mortem diagnosis of envenomation by a scorpion with or without a reliable history is a herculean task for any forensic pathologist. The challenge is compounded when stinging occurs at night, with the history remaining unreliable. The autopsy diagnosis is further complicated when the inflicted wound is small, and the mark is obliterated by healing within few days. As the venom of a scorpion is a mixture of enzymes, most of the forensic science laboratories in India fail to diagnose the poisoning. We present a case in which there was no external evidence of stinging, but the internal post-mortem findings along with histology of the organ systems pointed towards the diagnosis and were corroborated by the history. We reemphasise the importance of pathological sampling of organ systems, whenever there is death due to a suspicious, unknown insect bite.

1. Introduction

Scorpion stings are a major public health problem in many underdeveloped tropical countries including India.[1–4] Most scorpion envenomation occurs during the night due to the scorpion's nocturnal habit. In rural India, many people move bare-footed, frequently stamping on a scorpion that is difficult to recognise due its masking colour. Furthermore, scorpions can be found outside their normal range of distribution, that is when they crawl into luggage, boxes, containers or shoes and are unwittingly transported home via human travellers.

Accurate statistics on scorpion envenomation are not available. Many potentially dangerous scorpions inhabit the underdeveloped or developing world. Consequently, numerous envenomations go unreported, and true incidence is unknown. However, it has been estimated that, globally, there are 1.2 million scorpion stings per year.[1] Data from National Crime Records Bureau, India, suggests that approximately 10 000 people die every year due to scorpion stinging.[5]

Of the nearly 100 Indian species, the commonest and most venomous species is *Mesobuthous tumulus* (red scorpion).[3,6,7] Its venom is water-soluble, antigenic and consists of a heterogeneous mixture of neurotoxins and cardiotoxins that are contained in the stinger at the end of the tail. The components of the venom are complex and the main toxins include phopholipases, acetyl cholinesterase, hyaluronidase, haemorhaggins, coagulins, lecithin and neurotoxins.[7] The venom affects the sodium channels with prolongation of action potentials, as well as spontaneous depolarisation of nerves of both adrenergic and parasympathetic nervous systems.[8,9] Thus, both adrenergic and cholinergic symptoms occur. The venom also contains phospholipase-A, which causes gastrointestinal haemorrhages, pulmonary haemorrhages and disseminated intravascular coagulation.

The local features include intense burning pain and a red wheal with a hole in the centre at the site. The area may be red, swollen and tender. Systemic features include excessive sweating and salivation, hyperthermia with chills and headache, feeling of giddiness and fainting.[10] Apart from these, other reported systemic features include cardiac arrhythmia, myocarditis, pulmonary oedema and oliguria.[2,4,11] Other significant features, although rare, include gangrene of the affected part, toxic myocarditis, disseminated intravascular coagulation (DIC) and acute pancreatitis, occurring either alone or in combination.[4,6,8,10,12,13]

Scorpion stinging, especially in children, carries a high rate of mortality. A smaller child, a lower body weight and a larger ratio of venom to body weight lead to a more severe reaction. A mortality rate of 20% is reported in untreated babies, 10% in untreated school-aged children and 1% in untreated adults.[3,7,14] Illiteracy,

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poverty, ignorance, delay in recognition, traditional faith healers trying treatment in rural areas, lack of transport in difficult terrains and the non-availability of adequate treatment facilities in nearby hospitals add to the increased mortality in this part of the world.[4]

Annually, an estimated 10 000 autopsies of scorpion stinging deaths are being carried out by Indian pathologists. Most of the time, diagnosis is based upon the history and exclusion of other factors contributing to death. As the venom is a mixture of various enzymes, most forensic science laboratories cannot detect it. Furthermore, most of the clinical findings can be mimicked by a multitude of natural diseases. Hence, whenever the history is unreliable, the doctor will be in a predicament to ascertain the cause of death. We, therefore, present a case through which we will discuss how the autopsy findings lead to the diagnosis of scorpion stinging.

2. Case history

The dead body of an 8-year-old boy was brought to the mortuary with an unconfirmed history of scorpion envenomation. His past medical records were normal. He was allegedly stung by a scorpion on the right foot 2 days prior in the evening hours. He was admitted to a local hospital, diagnosed as autonomic dysfunction and unsuccessfully treated there. Hospital chest X-Ray showed extensive large patchy alveolar opacities on both sides, with air bronchogram sign suggesting bronchopneumonia. He was treated for pulmonary oedema under antibiotics cover.

External examination failed to confirm the stinging as there were many small abrasions over the feet, and there was no oedema, or redness of the foot. There were no other external signs suggestive of envenomation or any type of foul play.

3. Examination of the organ systems

The heart weighed 110 g, looked thin and pale with dilated chambers. Walls of ventricles were not thickened. The myocardium was flabby. The ventricular walls were much softer than expected. Initial sections from the left and right ventricular walls showed marked congestion. The coronary arteries were normal without any thrombus. Later sections of all the papillary muscles and the adjacent free subendocardial regions showed marked lymphocyte infiltrates. The myocardium showed focal myocytolysis (vacuolar degeneration), wavy fibres and focal hyalinisation.

Both lungs were heavy and oedematous. The left side weighed 445 g and the right side 490 g. Both lungs were firm with liver-like consistency and subcrepitant. Sectioning showed a hard reddish parenchyma with friable areas without crepitation. Microscopy showed marked congestion. Alveoli were filled with homogeneous eosinophilic proteinaceous material. Entrapped bubbles were seen as rounded spaces within the proteinaceous content, suggestive of pneumonitis. Megakaryocytes were present in the alveolar capillaries.

Pancreas was congested. Microscopy showed extensive parenchymal necrosis accompanied by interstitial haemorrhage, suggestive of acute haemorrhagic pancreatitis.

Both kidneys showed marked congestion; microscopy revealing cloudy changes.

Cause of death concluded was cardiogenic shock from myocarditis. The reasons were young boy allegedly stung by a scorpion, resulting in severe envenomation developing massive pulmonary oedema (cardiogenic and non-cardiogenic) with cardiac failure probably due to myocarditis as a result of the adrenergic storm, with no energetic management to combat the venom and its effect.

4. Discussion

4.1. Changes in the heart

Myocarditis is most commonly the result of an infectious process, other known causes being hypersensitivity and chemicals and radiations.[15] Hence, without the history of infections or exposure to radiation in a child, the probability of envenomation by a scorpion becomes high.[2,6,12] In a significant number of cases, acute myocarditis progresses to chronic dilated cardiomyopathy,[15] which was a significant finding during naked eye examination of the heart in this case.

As scorpion venom is a potent neuronal sodium channel activator, its envenomation results in excessive firing of neurons and sudden outpouring of endogenous catecholamines into circulation due to the autonomic storm evoked by delayed inactivation of neuronal sodium channels.[7,9,15] More than twice the amount of epinephrine is found in the circulation during an autonomic storm. These stimulate both the sympathetic and the parasympathetic nervous systems. In the sympathetic, both the alpha- and the beta-adrenergic receptors are stimulated.

There is increased release of acetylcholine (Ach) and catecholamines, which gives rise to cardiac arrhythmias. Bradycardia occurs due to the release of Ach by the action of toxin on the vagal ganglion and the post-ganglionic nerve endings in the heart. Hypotension is due to sinus bradycardia and arteriovenous (AV) blockade. Sinus tachycardia, ventricular ectopics and idioventricular rhythm occur due to activation of beta-adrenergic receptors in the heart. Changes found in the instant case may have occurred mainly due to the excessive catecholamines. Myocarditis occurs due to hypoxia resulting from the inotropic effects of catecholamines on the myocardium. Catecholamines are capable of enhancing oxygen consumption to the point of causing myocardial changes. Myocarditis may also results from the direct toxic effect of the venom on the myocardium.[15] Toxic myocarditis manifests by bundle branch block or ventricular fibrillation. Their development may be mediated by altered cellular calcium metabolism and a response to catecholamines.

4.2. Pancreatitis

The anatomic changes of acute pancreatitis strongly suggest autodigestion of the pancreatic substrate by inappropriately activated pancreatic enzymes. Among the many aetiologies of acute haemorrhagic pancreatitis, one significant cause is primary acinar cell injury triggered following shock and ischaemia. Therefore, in the absence of other causes such as trauma and metabolic disturbances such as alcoholism, hypercalcaemia and infections, the diagnosis pointed towards autonomic storm and resultant shock induced by scorpion envenomation.[8,13]

4.3. Pulmonary oedema

It is a dreaded complication in children. It is multifactorial in genesis and can be due to cardiac failure due to cardiac dysfunction, haemodynamic disorders due to increased preload or postload and severe dysrhythmias, or increased pulmonary vascular permeability due to the release of chemical mediators. In this case, alpha-1 receptor stimulation may have played an important role in the pathogenesis of acute refractory pulmonary oedema. Therefore, the sudden development of toxic myocarditis, pancreatitis along with pulmonary oedema in an otherwise healthy child with suspicious insect bite pointed more towards diagnosis of scorpion envenomation.[9–11]

5. Conclusion

Hence, in a child, without a medical history of infection, any significant pathology, with unconfirmed insect bite, if an autonomic storm develops progressing to myocarditis, pulmonary oedema and pancreatitis, the possibility of scorpion stinging should be strongly suspected.

From medicolegal point of view, history of scorpion stinging, especially during night, is unreliable in rural India. If antemortem diagnosis is not properly made, it becomes a challenge to the forensic pathologist to diagnose it during the postmortem examination. A thorough post-mortem examination with the pathologic sampling of the organ systems will be of immense help.

Conflict of interest

We hereby declare that there is no conflict of interest of the authors.

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Ethical approval

None declared.

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